Poster

Accessing and Utilizing Remote Sensing Data
For Vectorborne Infectious Diseases Surveillance and Modeling

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Background

The transmission of vectorborne infectious diseases is often influenced by environmental, meteorological and climatic parameters, because the vector life cycle depends on these factors. For example, the geophysical parameters relevant to malaria transmission include precipitation, surface temperature, humidity, elevation, and vegetation type. Because these parameters are routinely measured by satellites, remote sensing is an important technologic tool for predicting, preventing, and containing a number of vectorborne infectious diseases, such as malaria, dengue, West Nile virus, etc.

Methods

A variety of NASA remote sensing data can be used for modeling vectorborne infectious disease transmission. We will discuss both the well known and less known remote sensing data, including Landsat, AVHRR (Advanced Very High Resolution Radiometer), MODIS (Moderate Resolution Imaging Spectroradiometer), TRMM (Tropical Rainfall Measuring Mission), ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer), EO-1 (Earth Observing One) ALI (Advanced Land Imager), and SIESIP (Seasonal to Interannual Earth Science Information Partner) dataset. Giovanni is a Web-based application developed by the NASA Goddard Earth Sciences Data and Information Services Center. It provides a simple and intuitive way to visualize, analyze, and access vast amounts of Earth science remote sensing data. After remote sensing data is obtained, a variety of techniques, including generalized linear models and artificial intelligence oriented methods, can be used to model the dependency of disease transmission on these parameters.

Results

The processes of accessing, visualizing and utilizing precipitation data using Giovanni, and acquiring other data at additional websites are illustrated. Malaria incidence time series for some parts of Thailand and Indonesia are used to demonstrate that malaria incidences are reasonably well modeled with generalized linear models and artificial intelligence based techniques.

Conclusions

Remote sensing data relevant to the transmission of vectorborne infectious diseases can be conveniently accessed at NASA and some other websites. These data are useful for vectorborne infectious disease surveillance and modeling.

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NASA
Remote
Sensing
Spacecraft
Observatories

The transmission of vectorborne infectious diseases is often influenced by environmental, meteorological and climatic parameters. For example, the geophysical parameters relevant to malaria transmission include precipitation, surface temperature, humidity, elevation, and vegetation type. Because these parameters are routinely measured by satellites, remote sensing is an important technologic tool for predicting, preventing, and containing malaria transmission. Currently, there are 69 NASA remote sensing missions.

Some of the environmental determinants that are available as data products (**X**) or can be computed or inferred using satellite measurements are shown below. The sensors or spacecraft in red are US-Japan collaborated missions.

|	Ground Cover Type	Vegeta-tion Index	Surface Tempera-ture	Rainfall	Humidity
Landsat ETM+	computed	computed		inferred	
AVHRR	computed	X	over sea surface	inferred	
MODIS	computed	X	X	inferred	computed
TRMM	computed	computed		X	
ASTER	computed	computed		inferred	
EO-1 ALI	computed	computed		inferred	
GMAO Climate Forecast			X	X	X

Because rainfall is the most important environmental determinant for malaria transmission, we will explain how to obtain precipitation data acquired by **Tropical Rainfall Measuring Mission** in details. The **TRMM Online Visualization and Analysis System** is a convenient web-based tool to visualize TRMM data, perform certain analyses, and download data.
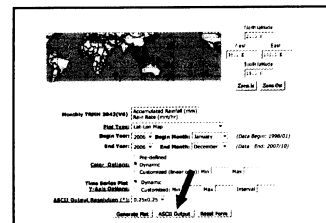
TRMM offers a variety of rainfall products
daac.gsfc.nasa.gov/techlab/giovanni ▶ TRMM
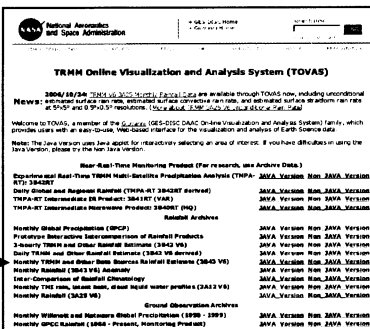
Directly accessing TRMM rainfall data by lifting ASCII data off screen
disc2.nascom.nasa.gov/Giovanni/tovas/TRMM_V6.3B43.shtml

For example, monthly precipitation is one of the parameters that can be obtained easily with the web-based TOVAS. Monthly rainfall distribution (mm/day) over Thailand in 2006 are shown below.

### TRMM Monthly Precipitation over Western Thailand in 2006 summarized by TOVAS
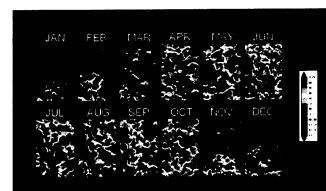
As another example, monthly rainfall (in mm/day) over the western Thai provinces bordering with Myanmar (15°N–20°N and 98°E–101°E) from 2000 to 2007 can also be obtained using TOVAS.

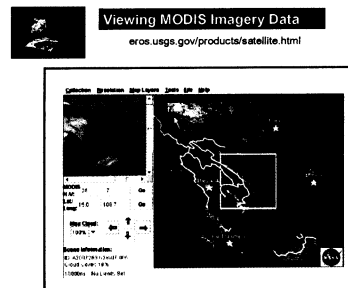### TRMM Monthly Precipitation Time Series over Thailand From 2000 to 2007 summarized by TOVAS
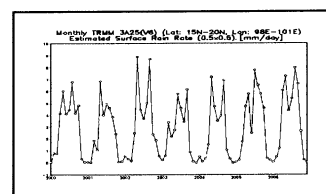
Viewing Landsat 7 ETM+ Imagery Data
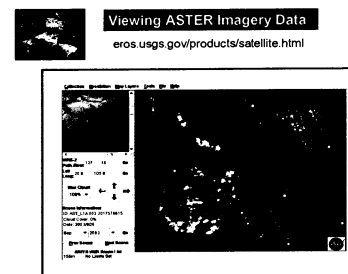eros.usgs.gov/products/satellite.html
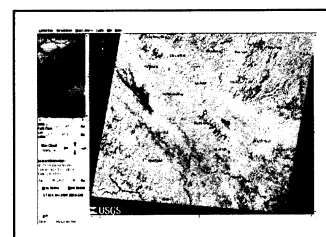
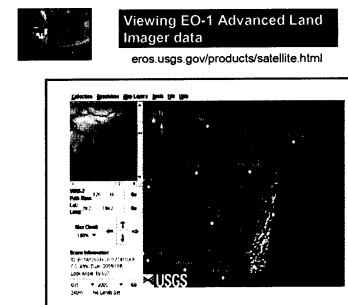## Viewing MODIS Imagery Data
eros.usgs.gov/products/satellite.html

Viewing ASTER Imagery Data
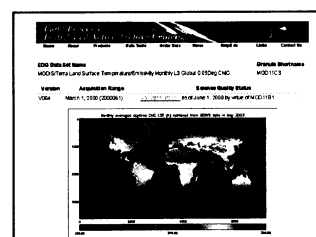eros.usgs.gov/products/satellite.html

Viewing EO-1 Advanced Land Imager data
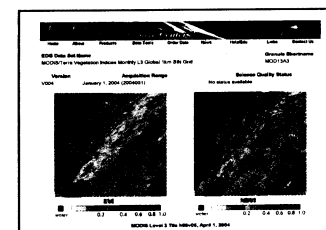eros.usgs.gov/products/satellite.html

Downloading or ordering MODIS surface temperature data product
lpdaac.usgs.gov/modis/mod11c3v4.asp

## Downloading or ordering MODIS vegetation data (NDVI) product
lpdaac.usgs.gov/modis/mod13a3v4.asp

An example for modeling malaria incidence

For example, we use rainfall, temperature, humidity, and vegetation index along with malaria time series to model and predict malaria incidence. Some of the geophysical parameters extracted from satellite measurements for the four seasons in Thailand are shown below.
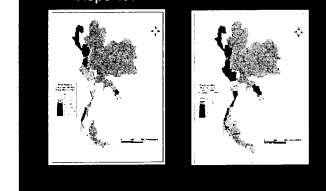
The four seasons we use are Cool-Dry (Nov–Jan), Hot-Dry (Feb– Apr), Early Rainy (May–Jul), and Late Rainy (Aug–Oct).

Surface Temperature

Vegetation Index

Rainfall
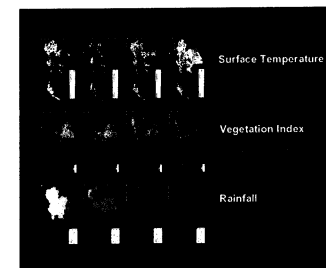
Neural network methods are used for prediction. Predicted incidence rates are in good agreement with reported rates.

Reported   Predicted

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